

MAMMOMAT Balance

SP

Maintenance Instructions

The Maintenance Protocol
SPB7-115.832.01...
is required for this instruction

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Chapter	Page	Revision
All	all	01

Document revision level

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1 General information

1.1 Training

- Self-instruction packet or training workshop and at least 1 installation

1.2 Required documents

- | | |
|--|-----------------------|
| • Planning Guide | SPB7-115.891.01.01.02 |
| • MAMMOMAT Balance Wiring Diagrams | SPB7-115.844.01.01.02 |
| • Installation and Start-up Instructions | SPB7-115.814.01.01.02 |
| • Maintenance protocol | SPB7-115.832.01.01.02 |
| • Instructions for use | SPB7-115.629.01.01.02 |
| • Service Instruction | SPB7-115.840.01.01.02 |

1.3 Required tools, measurement and auxiliary devices

- Oscilloscope
- Oscilloscope probe 1:100 > 600Vdc
- Digital multimeter
- Non invasive kVp-meter (mammo)
- Dosemeter (mammo)
- Service PC with serial port (connection cable is supplied with the unit)
- MAMMOMAT Balance SSW (Service Software Program is supplied with the unit)
- SIB phantom or Normi 7 or 4 cm Plexi or customer phantom (supplied by customer)
- Sensitometer / Densitometer
- Film pack 18x24 and 24x30 if it occurs
- Cleaning agents specified in the operating instructions
- Protective conductor meter
- Bathroom balance with tennis ball
- Spray enamel according to the PG (to touch up chipped paint)
- Standard installation tools
- Plexiglas phantom 2cm, 2cm, 2cm, 1cm, 0.5cm for AEC calibration (supplied with the unit)

1.4 Required lubricants

- All purpose grease PD2
- Viscogen oil

1 General information

1.5 Text emphasis

DANGER	DANGER indicates when there is an immediate danger that leads to death or serious physical injury.
WARNING	WARNING indicates a risk of danger that may lead to death or to serious physical injury.
CAUTION	CAUTION used with the safety alert symbol indicates a risk of danger that leads to slight or moderate physical injury and/or damage to property.
NOTICE	NOTICE used without the safety alert symbol indicates a risk of danger that if disregarded leads or may lead to a potential situation which may result in an undesirable result or state other than death, physical injury or damage to property.
NOTE	NOTE contains information provided with special emphasis to facilitate proper use of the equipment or proper execution of a procedure, i.e. hints, tips.

1.6 Safety Information and Preventive Measures

CAUTION

-
- When completing repair work and tests, please note:
 - the product-specific safety information in the document,
 - the safety information in TD00-000.860.01....
 - If the system is only switched off at the control panel, line voltage is present at: Mains input terminal blocks; Fuses F1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Main contactor TLR1 and emergency cut off buttons PB2 and PB3; Line filter FL1; PCB 03-186 and related parts (solid state relay RY1, resistor R1).
 - Voltage higher than 60Vac is present on: Terminal M3; Transformers TF155, TF165 and their connected parts; C-arm driving gear motor MT1 and limit switches MW1, MW2; Rotating anode starter 92-074 and capacitors C5, C6; Tube Rotating Anode Cable and supply connections.
 - After shut down, there may still be dangerous voltage up to 550Vdc on inverter power supply. Voltage decreases to zero by means of bleeder resistors in not less than 5 minutes due to capacitor size, energy stored is still dangerous if short to ground occurs when it's less than 60Vdc and till when capacitors are not fully discharged: Rectifier bridges PD1, PD2; Capacitors block C1, 2, 3, 4; Inverter block and electrical connection to High Voltage generator
 - High-voltage 20 ÷ 35 kV is present on: High Voltage generator; High voltage cable; X-ray tube.
 - Use ESD precautions for handling Printed Circuit Boards containing ESD sensitive components.
 - To prevent accidental triggering of High Voltage and X- Radiation output x-ray pushbutton has Dead Man function by which H.V. generator is disconnected by CPU if push button is not intentionally pressed. For more safety during intervention: 1) DEMO MODE can be selected by means of DIP 3 SW1 PCB 01-170. 2) Fuses F6, F9 can be removed and Inverter voltage monitor disabled by means of DIP2 SW2 set to ON. Vdc across C1,2,3,4, inverter and H.V. transformer will be zero after discharging time.
 - Tests or adjustments that must be made with radiation switched on are identified with the radiation warning symbol .
During these types of adjustments, radiation protective clothing must be worn.
-

1 General information

1.7 Explanation of abbreviations

Abbrev.	Explanation
SI	Safety Inspection
SIE	Electrical Safety Inspection
SIM	Mechanical Safety Inspection
PM	Preventive Maintenance
PMP	Preventive Maintenance Preventive Parts Replacement, External Inspection, etc.
PMA	Preventive Maintenance Adjustments
PMF	Preventive Maintenance , Function Check, Operating Value Check
Q	Quality Check
QIQ	Image Quality Check
QSQ	System Quality Check
SW	Software Maintenance
CSE	Customer Service Engineer
CS No.	Customer- Specific Number
IVK	Installed Volume Components

1.8 Symbols



Checks and adjustments that must be performed with radiation ON are identified by the radiation warning symbol.

2 System

SIM Radiation protection

- Check the radiation protection shield for possible damage (n°1, see figure).
- Information regarding the lead equivalent value must be legible.

SIM C-Arm – attachment and handles

- Check by pulling/pushing on both handles that no parts have got loosened (n°2, see figure).

SIM Tube cover

- Check that tube cover hasn't got loosened by pulling/pushing it in different directions (n°3, see figure).

SIM Table retain

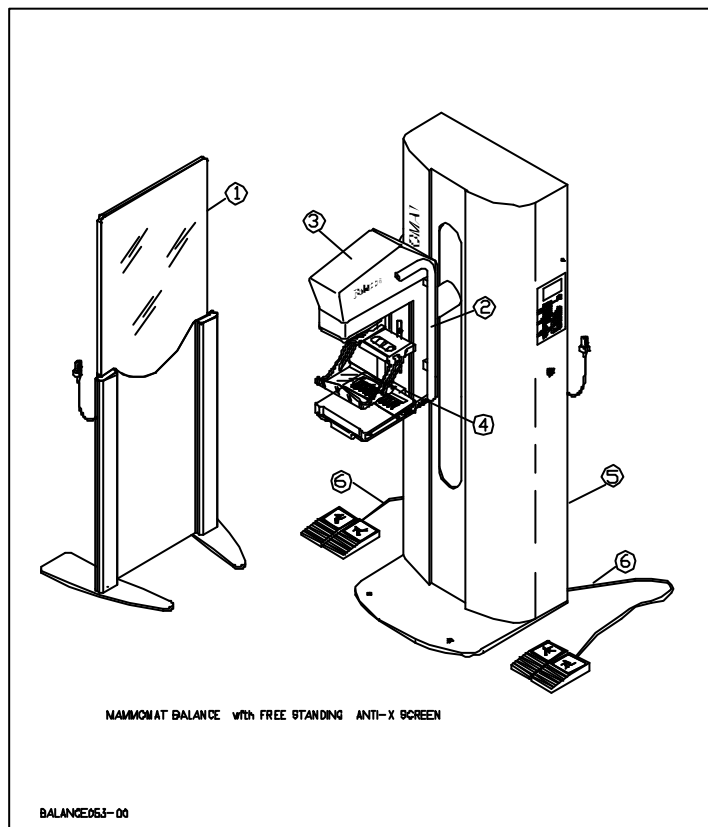
- Check that all tables are retained when inserted and can't be removed with very light pulling force.
- Inspect connectors and connector cover integrity on the table support (n°4, see figure).

SIE Cable

- System OFF
- Check the condition of the power connection cable and the corrugated tubing (n°5, see figure).
- Check the condition of foot pedal switches (n°6, see figure).

PMF Rotation movements

- Is the rotation smooth and noiseless through the entire range?
- Is the rotation brake holding the C-Arm position?
- Is the mechanical goniometer functional?
- Is the C-Arm rotation disabled without table?



3 Column stand

SIM C-Arm carriage wheels

- Do the wheels show any damage or sign of wear (n°1, see figure)?

SIM C-Arm carriage rails

- Do the rails show any damage or sign of wear or loosened fixation (n°2, see figure)?

SIM Gas spring

- Does the gas spring assembly show any damage or sign of wear or loosened fixation (n°3, see figure)?
- Does the alarm come out if safety micro-switch is disconnected (n°4, see figure)?

SIM Vertical C-Arm drive

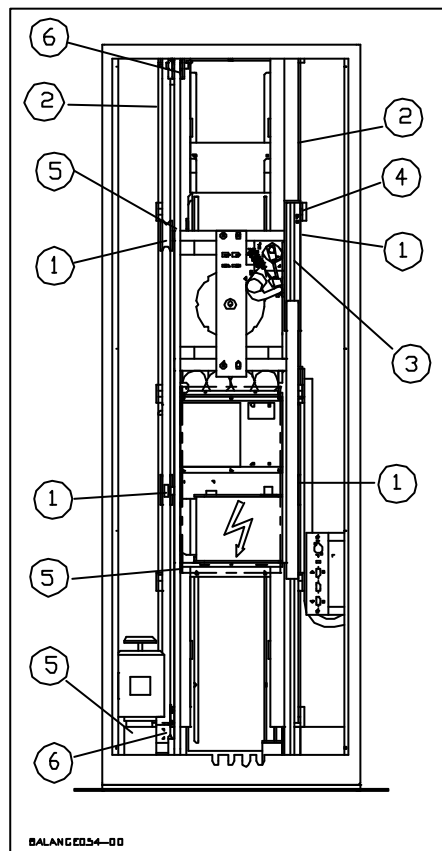
- Do the chain, chain fixation and gear box show any damage or sign of wear or loosened fixations (n°5, see figure)?

SIE Limit switches

- System ON. Move the lifting carriage up and down.
- Do the first limit switches MW4 (up) and MW3 (down) stop the carriage travel at the top and at the bottom?
- Manually activate safety switches MW2 (up) and MW1 (down) when carriage is at safety distance. Lifting carriage must be blocked.

PMF Vertical travel

- Is the vertical travel smooth and noiseless?



4 Compression System

SIM Testing the manual movement

- System OFF
- Move compression plate attachment Up/Down it must move free and without friction and noise

SIM Testing compression plate support

- Check that levers and retain pins are not damaged and release normally.
- Check for fixation of each compression plate

SIM Testing lexan of compression plates for wear and tear

- Check each plate for possible damage that can result harmful to patients.

SIM Check foot pedal switches functionality

- Check for each pedal switch functionality

SIM Testing magnification support fixation

- Check that the magnification platform can be fixed at 1,5x and 2x

SIM Testing the “Compression” force

- Use shifted compression plate, position a bathroom balance on the top of the table and tennis ball, select maximum compression force and check it.

SIM Testing the “Decompression” force

- Move compression plate up and check that force to stop it by hand is very light.

PMF Compression Thickness Display

- With large focus selected and compression plate in place check for compression thickness indication using Plexiglas phantom blocks to simulate breast thickness.
- Repeat with small focus and magnification platform + compression plate

If thickness value is not correct refer to service instructions SPB7-115.840.01..., chapter of dosimeter where source to skin distance calibration is described.

Breast thickness is obtained by such value subtracted by F.F.D.

5 Rotating anode starter

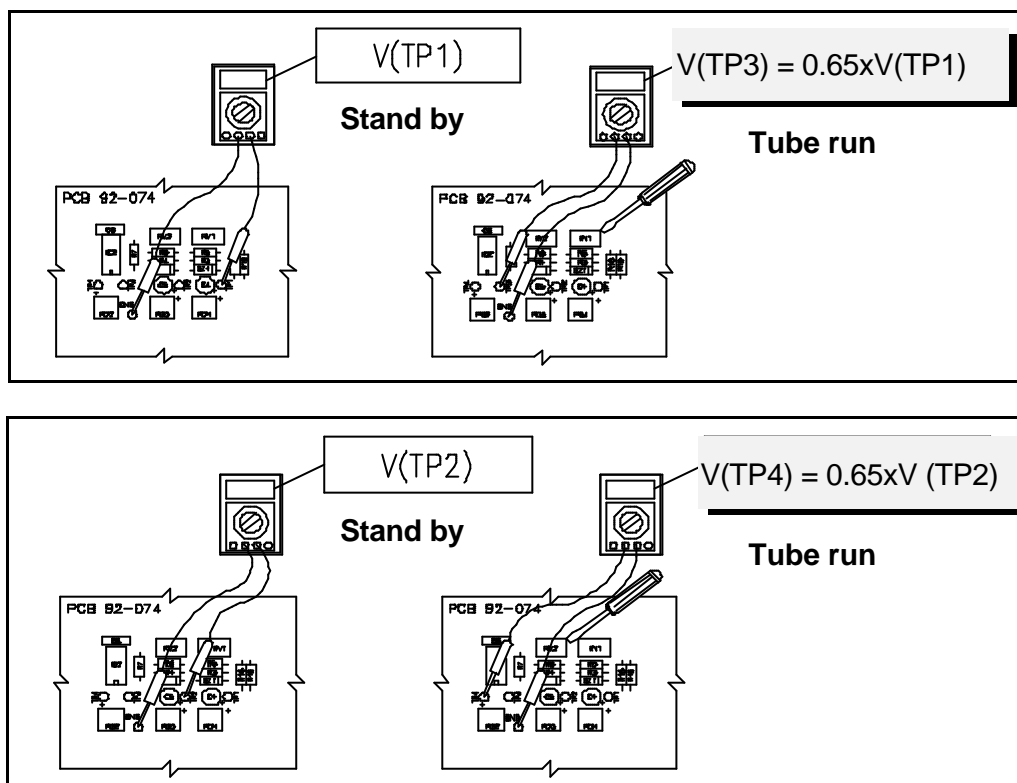
PMF Protection circuit check

- For protection circuit check, the anode must be put in rotation and it is advisable as follows:

DEMO mode with DIP 3 SW1 of board 01-170 switched ON

Manual mode with at least 200 mAs

In this mode, no X-rays are generated and measurement time is sufficiently long.



PMF Control LED (brake enabled)

- PCB 92-074

LED1	(yellow) bright during normal rotation phase (RUN)
LED2	(yellow) bright during breaking or alarm
LED3	(yellow) bright during breaking
LED5	(green) bright in stand by or rotation
LED6	(green) bright during rotation

5 Rotating anode starter

PMF Control LED (brake disabled)

- PCB 92-074

LED1	(yellow) bright during normal rotation phase (RUN)
LED2	(yellow) dark during breaking or alarm
LED3	(yellow) dark during breaking
LED5	(green) bright in stand by or rotation
LED6	(green) bright during rotation

PMF Brake disabling for heavy use

- If upon log file inspection high duty comes in evidence it' recommended to disable anode rotation brake to reduce operative tube assembly temperature.

For more details refer to service instructions SPB7-115.840.01....

6 Filament

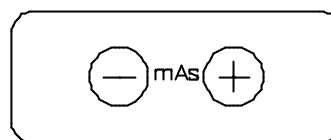
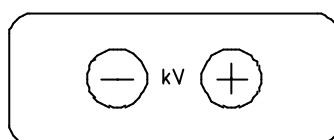
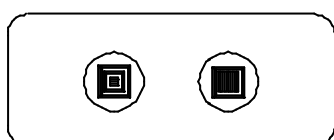


PMF Anode current check

Before entering any calibration mode, it's necessary to select the manual mode and 40mAs for **0.3 mm focus** or **13mAs** for **0.1 mm focus**.

In calibration mode, the following keys are active:

- Focal spot selection
- kV selection
- filament current adjustment by mAs + / - push buttons.



With reference to the tube calibration report:

- Set to ON **DIP1 SW1** of PCB **01-170** To access **mAH** current calibration
- Set to ON **DIP2 SW1** of PCB **01-170** To access **mAL** current calibration

In the mAs window of the display, the following parameters will appear:

- mAH or mAL, filament current I_f in Ampere;
- selected mAs
- after each exposure the expected anode current value and effective anode current in **mA**.

mAH	I_f	4,710	A
90	I_a	90,1	mA
mAs		40	

PMF Control LED

LED1 Bright in normal conditions.

LED3 Bright if small focus is selected

LED4 Bright if Filament is ON

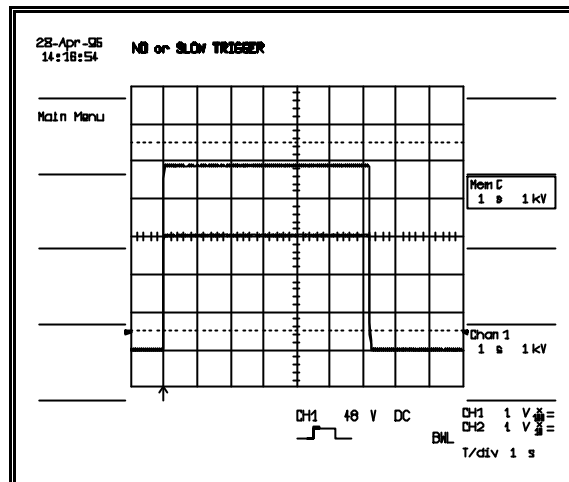
LED5 Bright during x-ray exposure. Brightness is proportional to tube anode current.

More details can be found in Service Instruction SPB7-115.840.01....

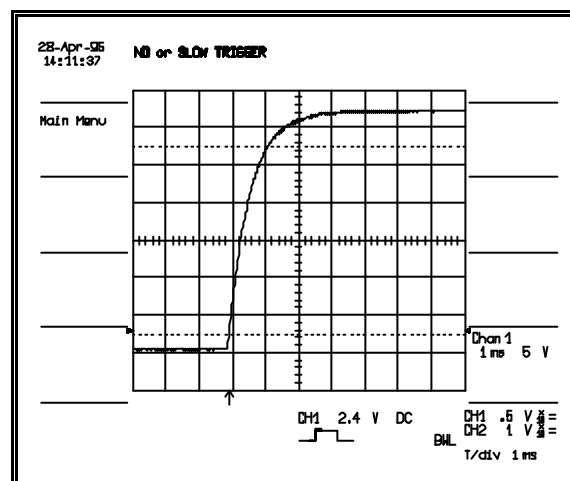
7 High tension power supply

7 High tension power supply

PMF kV waveforms



The oscillogram shows the H.V. waveform at 20 kV and 35 kV measured on TP1. kV wave form has no overshoot for any kV / mA loading factors combination.



kV risetime

PMF Internal kV check (TP1/TP2)

- DVM 1000Vdc f.s. or oscilloscope with 1:100 1000Vdc probe can be connected to TP1/TP2 (GND) of PCB 94-132, see page 17.
- Remove any table, select Manual Mode and an mAs value high enough to allow stable reading.

7 High tension power supply

KV	VTP1/2 ($\pm 1\%$)
20 kV	279 Vdc
21 kV	293 Vdc
22 kV	307 Vdc
23 kV	320 Vdc
24 kV	334 Vdc
25 kV	348 Vdc
26 kV	362 Vdc
27 kV	376 Vdc
28 kV	390 Vdc
29 kV	404 Vdc
30 kV	418 Vdc
31 kV	432 Vdc
32 kV	446 Vdc
33 kV	460 Vdc
34 kV	474 Vdc
35 kV	488 Vdc

kV to TP1/TP2 PCB 94-132 conversion table

NOTE

Values from the above table are valid only if VTP8 is 5.00 Vdc (standard calibration).
If for any reason kV are not correct within no more than 1kV calibration is possible
By means of RV5 PCB 94-132.
If calibration is necessary, Pivot value is 28kV
kV values are not affected by the replacement of Inverter or H.V. transformer if VTP8
is 5.00Vdc (standard calibration).

PMF External kV check

Measurement of the kV value with non-invasive instruments MUST be done exclusively with Molybdenum anode and Molybdenum filter without compression plate.

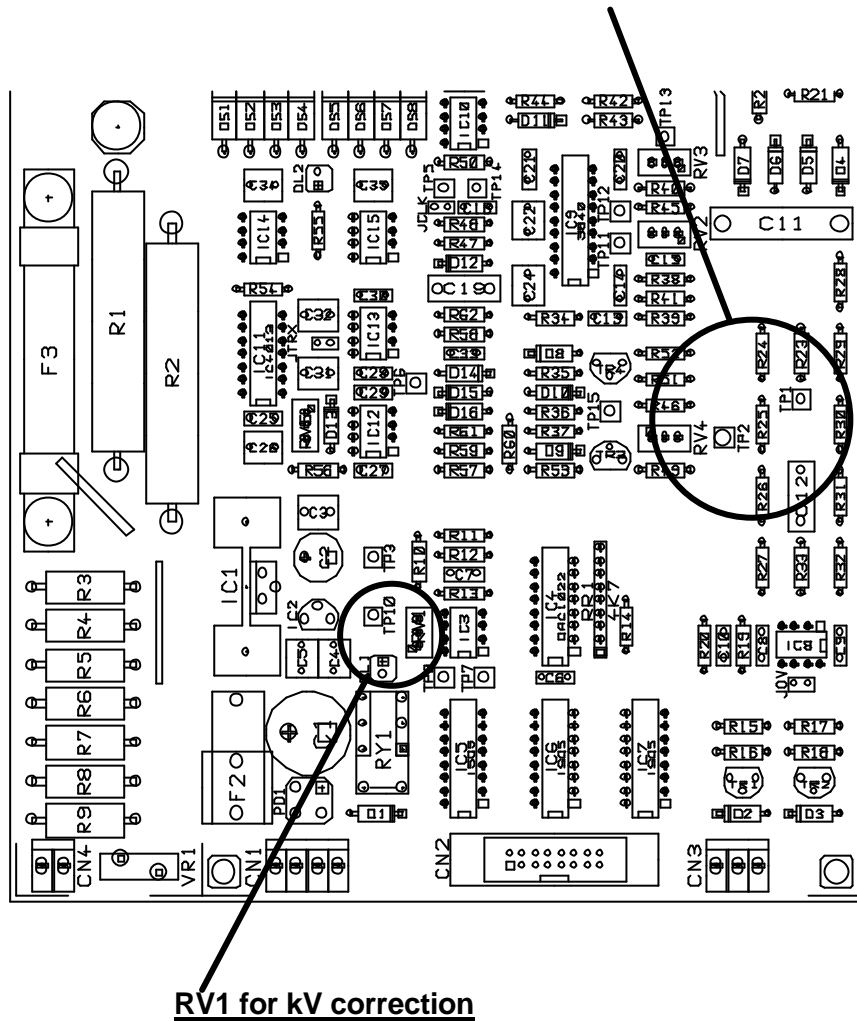
Measurement of the kV value done with non-invasive instruments is affected by intrinsic linearity error depending on the kV. It is advisable to refer to the instrument manual and in particular to the indications about corrective coefficients depending on the kV and the thickness of the Molybdenum filter. A tube that shows metallization problems on the ray window does not allow correct non invasive measurement of the kV and MUST nevertheless be replaced.

The most reliable and precise measurement is done with an external HV divider.

7 High tension power supply

PMF Checking and adjustment points

TP1-TP2 for kV checks on (PCB 94-132) of inverter block 08883436



PMF CONTROL LED

Green LED1 indicates that fuse F2 of PCB 94-132 is OK.

Yellow LED 2 turns on during exposure and can be used to verify continuous or pulsated X-ray emission.

8 Miscellaneous

SIE Testing the radiation field / light field



- Proceed with the test according to the Installation & Start-Up instructions SPB7-115.814.01... chapter "Checking the radiation field limitation".

PMF Automatic filter selection

- If it exists select it from the control panel and check that audible sound during movement is normal.

PMF RX signal lamp



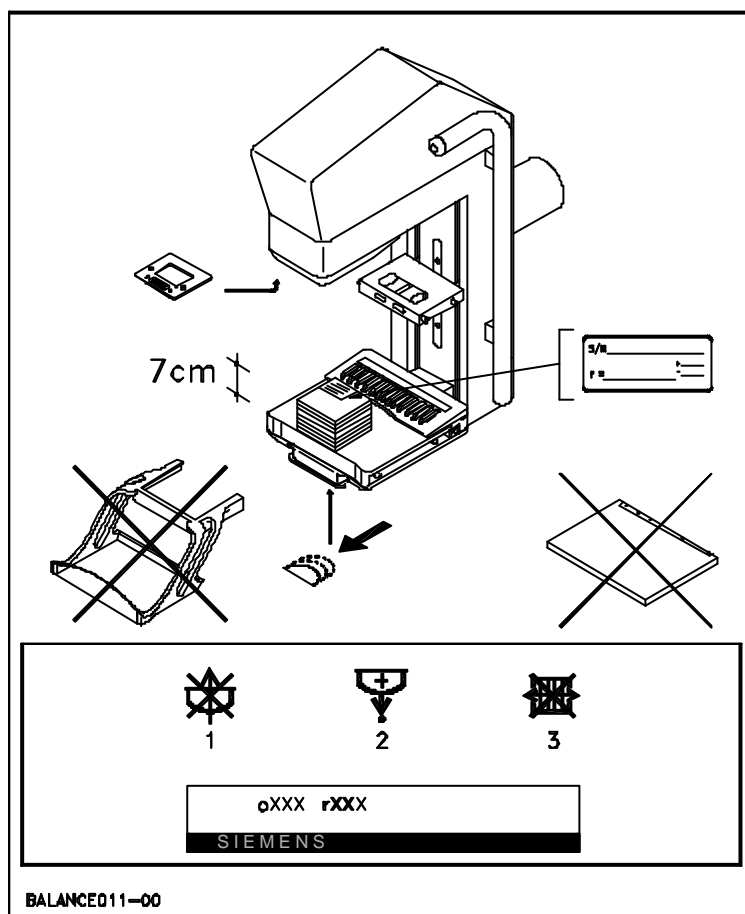
- Does the radiation-ON indicator light up?

PMF AEC Detector test



- Check the Sensibility test [r] parameter as following:

During the test, the system should be configured as shown in the figure below.



- Install Grid table 18x24
- Install 18x24 collimation plate
- Select LARGE focus
- Remove compression plate
- Remove cassette
- Select ZERO POINTS technique

8 Miscellaneous

- Disable potter bucky by inhibiting compressor release at exposure end and pressing the "Compression +" key
- Position detector at first stop on patient side
- Position the 7-cm-thick Phantom so to completely cover the detector.
- Repeat the test for each one of the three fields.

This configuration was so chosen as to exclude all variable elements that may exist between the X-ray source and the detector.

- Carry out an exposure and then check that [r] value is within ± 10 of the value from the phantom label.
- At the same time check that [o] value is not 0 (zero) or higher than 12.

If values are out of range adjust according to Service Instruction SPB7-115.840.01... .

SIE Calculated Dose test



- Refer to Service instruction SPB7-115.840.01... and check values according to previous calibration report.

PMF Table functions and safety locks

- Check that control LED and sensing micro-switches are working properly as described in the Instruction for use SPB7-115.629.01... .

PMF Blocking exposure release

- Exposure release must be blocked under the following conditions (indicated on the control console):
 - No cassette is inserted.
 - Cassette was not changed after the last exposure.
 - No collimation plate

SIE Emergency STOP

- Press Emergency STOP on each side of the unit, one at a time, and check that unit is completely switched OFF

SIE Exposure and error data recorder

- Read out the last 1300 exposures/errors memory and error log file with the Service PC and software .

SIE Delete Exposure and error memory

- Reset it by means of control panel pushbuttons 12 + 9 (+/-) all together, long beep will show that memory clear is in progress.

SIE Annotate exposure counters

- Unit has two different exposure counters that for different reasons can differ between them. Annotate exposure counter from technical menu and PCB 03-188

QIQ Testing film O.D. linearity



- Attach the most frequently used exposure system (e.g. grid table 18 x 24).
- Load the "test cassette" with film and insert it.
- Verify same conditions of previous calibration and/or maintenance

QIQ Testing image quality



- Attach the most frequently used exposure system (e.g. grid table 18 x 24).
- Load the "test cassette" with film and insert it.
- Position the SIB phantom over 2 cm Plexiglas or other IQ phantom (e.g. Normi 7).
- Select Zero Point mode and automatic decompression.
- Compress somewhat and release an exposure.

8 Miscellaneous

QIQ Phantom exposures

- Compare the phantom exposures with those on hand and / or archive them for the next maintenance as starting values.

9 Final tests

- Remove the measurement devices.

PMF Operating problems

- Were there any operating problems during the checks?

PMP Covers

- Attach all removed covers. Check that all covers are complete and firmly seated, including the cable ducts.

SIE Protective conductor test

- Perform the protective conductor test.

PMP Cleaning / Damaged paint

- Clean the unit using the materials recommended in the Instructions for use and repair any damaged paint.
- System ON.

QSQ Final test exposure



- Take one final test exposure.

10 Changes to previous version

10 Changes to previous version

Chapter	Page	Change
n.a.	n.a.	n.a.